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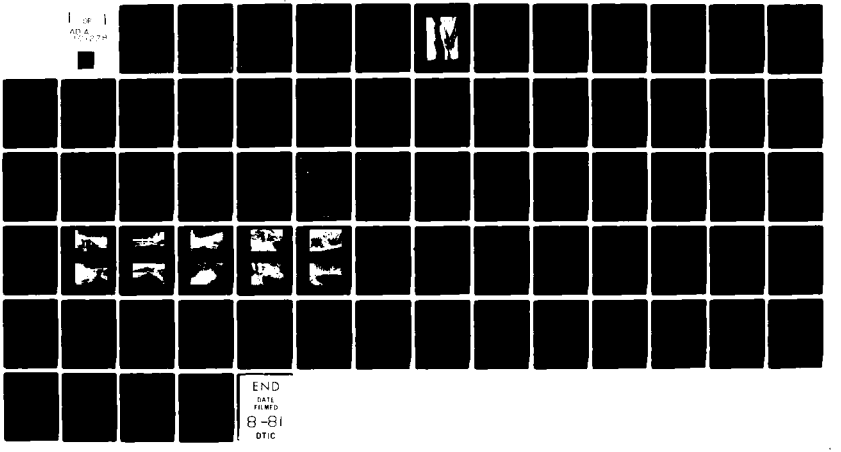

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DELAWARE RIVER BASIN
TRIBUTARY OF POHOPOCO CREEK
PENNSYLVANIA

NDI ID PA 00571
PA DER 45-258

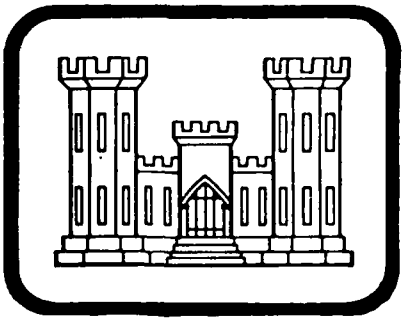
LEVEL II

AD A101278

HEMLOCK LAKE DAM

OWNED BY
HEMLOCK LAKE PROPERTY OWNERS ASSOCIATION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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PREPARED FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
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DELAWARE RIVER BASIN

HEMLOCK LAKE DAM
PENNSYLVANIA

NDI ID PA 00571

OWNED BY
HEMLOCK LAKE PROPERTY OWNER'S ASSOCIATION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Prepared for:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
1617 JF Kennedy Boulevard - Suite 1760
Philadelphia, Pennsylvania 19103

(13) Contract DACW31-81-C-0016

(11) APRIL 1981

(12) 70

AD A102063

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Hemlock Lake Dam
State Located:	Pennsylvania
County Located:	Monroe
Stream:	Tributary of Pohopoco Creek
Coordinates:	Latitide 40°55.3', Longitude 75°27.7'
Dates of Inspection:	December 19, 1980 and March 12, 1981

ASSESSMENT

Hemlock Lake Dam is an earth embankment about 450 feet long and 27 feet high. An ungated overflow spillway is located at the right abutment. A paved roadway has been constructed on the dam crest and a bridge has been constructed over the spillway. The dam was constructed in the early 1950's to provide a lake for recreational purposes.

Hemlock Lake Dam has a maximum storage capacity of 117 acre-feet and a maximum height of 27 feet. The dam is classified as "Small" size. Due to the potential for excessive property damage and the loss of more than a few lives in the damage center which consists of 5 houses with door sills as low as 5 feet above the stream bed located within 1,500 feet downstream of the dam, the structure is classified as a "High" hazard.

Examination of the results of the hydrologic and hydraulic analyses indicates that the spillway is capable of passing approximately 26 ~~percent~~ of the Probable Maximum Flood (PMF) without the dam being overtopped. The selected Spillway Design Flood (SDF) for this "Small" size, "High" hazard potential structure is the PMF. The water surface elevation at the damage center is 2.4 feet higher for the breach condition than for the non-breach condition. The spillway is classified as "Seriously Inadequate, Unsafe, Non-Emergency" since breaching of the dam significantly increases the downstream hazard potential.

Based on visual observations and a review of the information obtained from the Pennsylvania Department of Environmental Resources (DER), Hemlock Lake Dam appears to be in poor condition.

Recommendations and Remedial Measures

The following recommendations and remedial measures should be initiated immediately.

The Owner should retain the services of a licensed professional engineer experienced in the design and construction of dams to assist in complying with the following recommendations and remedial measures.

a. Facilities

1. Detailed hydrologic and hydraulic analyses should be performed to evaluate the discharge capacity of the spillway and remedial measures should be taken to increase the spillway capacity.

2. All depressions in the downstream embankment face should be filled with suitable compacted material.

3. An investigation should be made to assess the source and extent of the seepage observed at the downstream toe of the dam.

4. A stability analysis of the embankment should be made.

5. The embankment should be cleared of all trees, stumps and brush and the resulting voids should be backfilled with suitable compacted material. A grass cover should be established and maintained on the slopes of the dam.

6. Assess the need for embankment protection on the upstream face of the dam.

7. The operability of the reservoir drain valve should be determined, and if not operable, should be made operational.

8. Provisions should be made for the emergency closure of the upstream end of the outlet pipe.

9. The adequacy of the energy dissipator at the downstream end of the spillway chute during high discharge conditions should be evaluated.

10. Repair minor spalling of concrete on the approach channel walls of the spillway.

b. Operation and Maintenance Procedures

1. A regular inspection and maintenance program should be developed and implemented.

2. A system for warning downstream residents in the event of an impending dam failure should be developed.

O'BRIEN & GERE ENGINEERS

Date: 29 April 81

Peter C. Johnson, P.E.
Senior Vice President
Pennsylvania Registration No. PE-02246-E

Approved by: Date: 22 May 81

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

OVERVIEW FROM THE DOWNSTREAM RIGHT ABUTMENT.

TABLE OF CONTENTS

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
HEMLOCK LAKE DAM
NDI ID PA 00571
PA DER 45-258

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if Hemlock Lake Dam constitutes a hazard to human life or property.

1.2 Description of Project (Based on information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania, and from the field inspection.)

a. Dam and Appurtenances. Hemlock Lake Dam is an earth embankment approximately 450 feet long with a maximum height of 27 feet. An ungated concrete overflow spillway, 15 feet wide, is located at the right abutment of the embankment. The crest of the embankment is paved with asphalt and a concrete decked bridge has been constructed over the spillway.

The dam, which is located at the southern end of the impoundment, has a crest width of about 17 feet. The approximate upstream and downstream slopes of the embankment are 3H:1V and 1.5H:1V, respectively.

The spillway has a rectangular cross section with a clear vertical opening of 3.2 feet to the bottom of the bridge deck. The spillway chute is lined with concrete to the downstream toe of the embankment.

The surface area of the impoundment is 9.2 acres at normal pool. The reservoir is used for recreational purposes.

b. Location. Hemlock Lake Dam is located on a tributary to Pohopoco Creek in Monroe County, Polk Township, Pennsylvania. The dam and impoundment are shown on USGS Quadrangle sheet titled "Brodheadsville, PA" at coordinates N $40^{o}55.3'$, W $75^{o}27.7'$ approximately 4 miles west of Brodheadsville, Pennsylvania. A regional location plan of Hemlock Lake Dam is included as Figure 1, Appendix E of this report.

c. Size Classification. The maximum height of Hemlock Lake Dam is 27 feet and the maximum reservoir storage is 117 acre feet. The dam is therefore classified as a "Small" size dam (height less than 40 feet and storage less than 1,000 acre feet).

d. Hazard Classification. Five houses which would be affected by the failure of the dam are located within 1,500 feet downstream of the dam. Door sills of the dwellings are as low as five feet above the streambed. Therefore, the dam is classified as a "High" hazard structure due to the potential for the loss of more than a few lives and excessive property damage.

e. Ownership. The dam is owned by the Hemlock Lake Property Owner's Association. All correspondence should be directed to: Hemlock Lake Property Owners' Association, RD 2, Kunkletown, PA 18058, Attention: Mr. Emil Zullo, President.

f. Purpose of Dam. The dam was constructed to provide a reservoir for recreational purposes. The reservoir is currently being used for this purpose.

g. Design and Construction History. The dam was designed by Mr. Michael A. Policelli, P.E. No permit application, design drawing or calculations have been made available. Based on a review of available information, it appears that the dam was constructed in the early 1950's. The original owner was Mr. John Roberts and the contractor was Mr. Herbert Gower. According to the Owner's representative, the original dam was apparently constructed without a spillway. During tropical storm Diane (1955), the embankment was overtopped and partially eroded. A temporary spillway was constructed between 1955 and 1960. In 1960, the present spillway was constructed.

In 1962, additional repairs made to the dam included the placement of a clay blanket on the upstream face of the dam and the placement of a concrete cut-off wall at the upstream end of the spillway inlet channel in the vicinity of the right abutment. These repairs were made to reduce seepage through the dam.

h. Normal Operating Procedures. No written operational procedures exist for this site. No restraints to flow are located in the spillway. No known minimum daily release rates are required. The reservoir drain valve is not operated on a regular basis.

1.3 Pertinent Data

a. Drainage Area (Square Miles)	0.48
b. Discharge at Dam Site (CFS)	
Maximum Spillway Capacity (EL 769.7)	235.
c. Elevations (Feet above MSL)	
Top of Dam (Low point, design top of dam unknown)	769.7
Spillway Crest	766.0
Normal Pool	766.0
Streambed at Dam (downstream toe)	743.0
Pipe Invert (Reservoir Drain)	743.0

d. Reservoir Length (Feet)

Normal Pool, Elev 766	800
Maximum Pool, Elev. 769.7	900

e. Reservoir Storage (Acre-Feet)

Normal Pool, Elev. 766	80
Maximum Pool, Elev. 769.7	117

f. Reservoir Surface (Acres)

Normal Pool, Elev. 766	9.2
Maximum Pool, Elev. 769.7	11.6

g. Dam Data

Type	Earth Embankment
Length	450 feet
Height	27 feet
Top Width	17 feet
Side Slopes (Upstream)	3H:1V
(Downstream)	1.5H:1V
Zoning	No information available
Impervious Core	Upstream Clay blanket
Foundation Treatment	No information available

h. Diversion System

None

i. Spillway

Type	Broad Crested Weir
Length	15 feet
Height	3.2 feet
Control	None
Energy Dissipator	Concrete projection at downstream end of chute discharge channel
Downstream Channel	Concrete lined chute to natural stream

g. Outlet Works

Reservoir Drain	Eight-inch diameter cast iron pipe, control valve located at outlet

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. No engineering data was made available for Hemlock Lake Dam. Information made available by Pennsylvania DER consisted of inventory sheets prepared by the Corps of Engineers and a brief description compiled by Pennsylvania DER.

b. Design Features. The design features are described in Section 1.2.a and are shown on the drawings in Appendix E.

2.2 Construction

According to the Owner's representative, the dam was originally built during the early 1950's. No information concerning the original construction of the dam is available. Modifications to the dam were made in 1960 (spillway) and in 1962 (clay blanket on the upstream face of the dam and the placement of a cut-off wall at the upstream end of the spillway inlet channel in the vicinity of the right abutment).

2.3 Operational Data

No operational data is available for the dam.

2.4 Evaluation

a. Availability. All data utilized in this report was provided by the Pennsylvania DER and supplemented by conversations with the Owner's representative.

b. Adequacy. The information made available by the Pennsylvania DER, conversations with the Owner's representative and observations made during the field investigation provided adequate data for a Phase I evaluation.

c. Validity. There appears to be no reason to question the validity of the limited data available.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. At the time of the initial inspection on December 19, 1980, the water surface was approximately three feet below the spillway crest. At the subsequent inspection on March 12, 1981, the water surface was at the spillway crest. No underwater areas were inspected. The observations and comments of the field inspection team are presented in Appendix A of this report.

The appearance of the facility indicates that the dam and appurtenances receive limited maintenance.

b. Dam. (Left and right hand designations are referenced looking downstream.)

The horizontal alignment of the upstream face of the dam, which is covered with brush and weeds, appears to be good. No areas of slope failure were noted. No embankment protection is provided for the upstream face. A non-uniformity in the profile of the upstream face is evident for the full length of the embankment. A number of trees, with trunks about 6 inches in diameter and 20 to 25 feet high, are located on the upstream face near the left abutment.

The crest of the dam, which is asphalt paved, is used as a roadway. A survey along the centerline of the crest of the dam was made by the inspection team and is reproduced in Appendix A, Sheet 11B. The maximum variation in elevation over the length of the embankment is about 2 feet.

The downstream face of the embankment is on a slope of approximately 1.5H:1V. Most of the downstream face of the dam is overgrown with brush and trees. Some attempts have been made to control vegetation on the downstream face since many tree stumps are evident. The downstream face of the dam has many bulges and depressions for the full length of the embankment.

Seepage (100 gpm) was observed at the toe of the dam from near the left abutment and to about 50 feet right of the reservoir drain outlet, a total distance of about 250 feet. Seepage did not appear to contain soil particles, but iron-oxide coloring was observed at some locations.

c. Appurtenant Structures. The rectangularly shaped concrete spillway is located at the right abutment. Most of the concrete appears to be in good condition, with some minor spalling noted on the right training wall of the approach section. No settlement was observed in the spillway.

The spillway outlet chute is concrete lined and extends to the toe of the embankment near the junction of the embankment and the right abutment. The concrete in the chute appears to be in good condition. During the inspection made

on March 12, 1981, seepage (1 gpm) was observed discharging from a joint on the right side of the spillway discharge chute about 30 feet downstream of the control section of the spillway. No settlement of the individual concrete sections of the chute were noted.

No accumulation of debris was noted in the spillway or in the outlet chute. A small concrete projection is located in the invert at the downstream end of the chute which functions as an energy dissipator. The concrete decked steel bridge over the spillway appears to be in good condition.

The intake for the reservoir drain is submerged. The outlet valve is located at the downstream end of the pipe enclosed by a steel box. The valve box could not be opened for the inspection; therefore, the operability of the valve could not be determined.

d. Reservoir. The slopes adjacent to the impoundment are moderate and covered with vegetation. No evidence of slope instability was observed.

e. Downstream Channel. The reservoir drain and spillway outlet chute discharge into the natural channel downstream of the dam. The channel is about 10 feet wide with approximately 2H:1V side slopes which are about 3 feet high and the average channel slope is about 1.3 percent. Five houses, with door sills as low as five feet above the stream bed, are located within the first 1,500 feet downstream of the dam.

3.2 Evaluation

Based on visual observations, the dam and appurtenances appear to be in poor condition. Recommendations and remedial measures are presented in Section 7.2 of this report.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

According to the Owner's representative, no written operational procedures exist for the dam. The impoundment is normally maintained at the normal pool for recreational purposes.

4.2 Maintenance of the Dam

According to the Owner's representative, no written maintenance procedures for the dam exist. The Board of Directors of the Hemlock Lake Owners' Association make an annual inspection of the dam.

Based on the visual inspection, it appears that an effort has been made to remove trees from the downstream face of the dam. The spillway and spillway outlet chute were clear at the time of inspection.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, no written maintenance procedures for the operating facilities exist. The control valve for the reservoir drain was last operated three years ago. The Owner's representative believes that the control valve is operational.

Screens are located at the drain intake, according to the Owner's representative; however, the reservoir must be drained to clean the screens.

4.4 Description of Any Warning System in Effect

According to the Owner's representative, no formal warning system or procedures are established for monitoring the structure during periods of heavy rainfall or in the event of impending dam failure; however, a local resident inspects the dam periodically during intense rainfall and would personally notify the residents living downstream of the dam in the event of an impending failure.

4.5 Evaluation

Periodic inspection of the dam and appurtenances should be made by a qualified engineer. All controls should be operated for this inspection.

A formal maintenance program for the dam and appurtenances should be developed and implemented. Records of maintenance performed should be recorded by the Owner. A formal warning system relative to the houses downstream of the dam must be developed.

The valve located on the downstream end of the reservoir drain pipe is considered inadequate since discharge through the pipe could not be stopped in the event of a leak in the pipe. Provisions should be made for control of the reservoir drain pipe discharge upstream of the embankment.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data The computed drainage area for Hemlock Lake Dam is about 0.48 square miles. The basin has a maximum length of about one mile and a maximum width of about 0.6 miles. The ground surface elevations vary from about 1,080 in the upper reaches of the drainage area to 766 at normal pool. The drainage area is essentially undeveloped forest and pasture land with residential development limited almost entirely to the immediate area of Hemlock Lake.

b. Experience Data. Rainfall and spillway discharge records are not maintained by the Owner. According to the Owner's representative, the embankment was overtopped during tropical storm Diane (1955). The dam did not have a spillway at that time.

c. Visual Observation. The spillway would appear to function adequately up to its capacity for discharge through the bridge opening. It is doubtful that the energy dissipator located at the downstream end of the spillway outlet chute would prevent erosion downstream of the chute. This could lead to erosion in the vicinity of the outlet of the spillway chute during periods of high discharge.

d. Overtopping Potential. The overtopping potential of the dam was estimated using the HEC-1, Dam Safety Version, computer program. A brief description of the program is included in Appendix D.

Hemlock Lake Dam is classified as a "Small" size, "High" hazard dam. Accordingly, the Spillway Design Flood (SDF) ranges from fifty percent of the Probable Maximum Flood (PMF) to the full PMF. Because of proximity of the five houses located within the first 1,500 feet downstream of the dam and the potential for the loss of more than a few lives, the PMF was selected as the appropriate SDF. The PMF was routed through the reservoir with the starting water surface elevation at the spillway crest, Elev. 766.0. The peak inflow and outflow during the PMF are both about 1,180 cfs. The embankment would be overtopped by 1.3 feet for about 8.5 hours during this event. The spillway is capable of discharging about 26 percent of the PMF before overtopping of the embankment occurs.

e. Spillway Adequacy. In order to assess the potential for increased damage due to dam failure, the embankment was assumed to breach with water flowing 0.50 feet over the low point of the top of the dam for a period of 2 hours. A review of the results of this analysis indicates that the water surface elevation at the damage center is 2.5 feet higher for the breach condition than for the non-breach condition. Water would be in the houses within the first 1,500 feet downstream of dam to a depth of 0.8 feet for the breach condition. The spillway is classified as as "Seriously Inadequate, Unsafe, Non-Emergency" since the breaching of the dam significantly increases the downstream hazard potential.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Obserations. The overall structural appearance of the dam at the time of the inspections was poor. The source of the seepage (100 gpm) apparent for about 250 feet along the downstream toe of the dam should be investigated to evaluate the effect of the seepage on the stability of the embankment. The bulges and depressions in the downstream face of the dam may be the result of poor construction control. No cracking in the embankment was noted. The non-uniformity of the upstream face is due to the placement of the clay blanket after the initial construction of the dam.

Because of the steep 1:5H:1V downstream slope of the embankment and the saturated condition of the foundation, the stability of the embankment is questionable, even through presently no indications of movement or slope failure are apparent.

b. Design and Construction Data. Design and construction data is unavailable for this dam.

c. Operating Records. According to the Owner's representative, operating records are not maintained for this dam.

d. Post Construction Changes. A spillway was constructed in 1960. In 1962, a clay blanket was placed on the upstream face of the embankment and a concrete cut-off wall was built at the upstream end of the spillway inlet channel. Both of these measures were taken to reduce seepage through the embankment.

e. Seismic Stability. Hemlock Lake Dam is located in Seismic Zone 1 as shown on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 is considered to be safe under any expected Zone 1 earthquake loading conditions if it is stable under static loading conditions. Since the dam does not appear to be structurally stable for potential static loadings, it is doubtful that it would be stable for seismic loadings.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Evaluation. Based on visual observations made during the field inspections, the dam and appurtenances appear to be in poor condition. A thorough visual inspection of the embankment, however, was prohibited by the thick overgrowth.

The source of the seepage (100 gpm) observed along the toe of the dam could not be determined during the inspection. According to the Owner's representative, a clay blanket was placed on the upstream face of the dam in 1962 to reduce seepage.

The bulges observed on the downstream face appear to be the result of poor construction control. Trees were observed on the upstream face of the embankment near the left abutment. No cracks or evidence of recent movement were noted in the embankment.

The selected SDF for Hemlock Lake Dam is the PMF. Based on a review of the hydrologic/hydraulic analyses, the spillway is capable of passing about 26 percent of the PMF before the embankment would be overtopped. The spillway is classified as "Seriously Inadequate, Unsafe, Non-Emergency" since breaching of the dam seriously increases the downstream hazard potential.

Because of the location of the spillway near the right abutment and restrictions caused by the bridge over the spillway, it appears that the spillway opening could become blocked with debris. During heavy rainfall, blockages in the spillway would seriously reduce the spillway capacity.

b. Adequacy. The information made available by Pennsylvania DER, conversations with the Owner's representative and observations made during the field investigation provided adequate data for a Phase I evaluation.

c. Urgency. The remedial measures recommended in Section 7.2 should be implemented immediately.

d. Necessity for Further Investigations. Further investigation should be implemented as discussed in Section 7.2.

7.2 Recommendations and Remedial Measures

The following recommendations and remedial measures should be initiated immediately.

The Owner should retain the services of a licensed professional engineer experienced in the design and construction of dams to assist in complying with these recommendations and remedial measures.

a. Facilities

1. Detailed hydrologic and hydraulic analyses should be performed to evaluate the discharge capacity of the spillway and remedial measures should be taken to increase the spillway capacity.

2. All depressions in the downstream embankment face should be filled with suitable compacted material.

3. An investigation should be made to assess the source and extent of the seepage observed at the downstream toe of the dam.

4. A stability analysis of the embankment should be made.

5. The embankment should be cleared of all trees, stumps and brush and the resulting voids should be backfilled with suitable compacted material. A grass cover should be established and maintained on the slopes of the dam.

6. Assess the need for embankment protection on the upstream face of the dam.

7. The operability of the reservoir drain valve should be determined, and if not operable, should be made operational.

8. Provisions should be made for the emergency closure of the upstream end of the outlet pipe.

9. The adequacy of the energy dissipator at the downstream end of the spillway chute during high discharge conditions should be evaluated.

10. Repair minor spalling of concrete on the approach channel walls of the spillway.

b. Operation and Maintenance Procedures

1. A regular inspection and maintenance program should be developed and implemented.

2. A system for warning downstream residents in the event of an impending dam failure should be developed.

APPENDIX A

INSPECTION CHECKLIST

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam Hemlock Lake Dam County Monore State Pennsylvania National ID # PA 00571

Type of Dam Rolled Earth Hazard Category High

Date(s) Inspection 12/19/80 3/12/81 Weather Partly Cloudy (12/19/80) Temperature 20° (12/19/80)

Pool Elevation at Time of Inspection ±763 M.S.L. (12/19/80) Tailwater at Time of Inspection ±743 M.S.L. (12/19/80)

Inspection Personnel:

L. Beck
L. DeHeer (3/12/81)
R.E. Horvath
R. Beck
J. Rauschkolb

R.E. Horvath Recorder

Remarks:

The inspection team was accompained by Mr. George Harris representing The Hemlock Lake Property Owners' Association. Both 12/19/80 & 3/12/81

Sheet 1 of 11

DRY STONE MASONRY WALL
(DOWNSTREAM FACE OF DAM)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Seepage was noted at the toe of the wall. The limits of seepage extend from about the midpoint of the spillway to the left abutment toe, a distance of about 90 feet. Seepage was also noted at an elevation 3 to 4 feet below the spillway crest for most of the length of the spillway.	The quantity of seepage is appreciable (50gpm); however, the water is clear.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	The abutment/embankment junctions appear to be satisfactory with no seepage noted.	
DRAINS	The dry stone masonry wall is free draining.	
WATER PASSAGES	Seepage was noted along perimeter of the reservoir drain pipe and as discussed under "any noticeable seepage".	The seepage around the reservoir drain pipe is an additional 20gpm. See remark under "any noticeable seepage".
FOUNDATION	Not observed.	

Sheet 2 of 11

DRY STONE MASONRY WALL
(DOWNSTREAM FACE OF DAM)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	The masonry wall was constructed as a dry rubble wall.	
STRUCTURAL CRACKING	Cracks were noted in cemented masonry training walls on either side of the spillway. The cracks extend from the crest to the water line on slopes approximating 30^{o} from vertical in the downstream direction.	Repair the cracks in the cemented masonry training walls.
VERTICAL AND HORIZONTAL ALIGNMENT	Horizontal and vertical alignments appear to be satisfactory. A portion of the concrete cap on the spillway crest about 8 feet long is missing.	Replace the portion of missing concrete cap.
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	Some of the stones in the wall have been displaced. The most prominent location is about the midpoint of the spillway just above the toe. The limits of displaced stone is about 4 feet by 4 feet in area and 2 feet deep.	Replace the missing stones.

Sheet 3 of 11

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Several bulges were noted in the downstream face.	The condition appears to have occurred during or soon after construction was completed. No embankment cracking was noted.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	A break in the profile of the upstream face was noted. The break extends for the full length of the embankment at about El. 762.	The break in slope profile is apparently due to the placement of a clay blanket on the upstream face after construction was completed.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The horizontal alignment of the crest appears to be good. A review of the results of the field survey revealed that the maximum variation in vertical alignment is about 2 feet. No information relative to the design top of dam is available.	
RIPRAP FAILURES	Riprap has not been placed on the slopes.	Consideration should be given for placing riprap on the upstream face of the dam to protect against wave action.

Sheet 4 of 11

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DRAINS	The dam does not have an internal drainage system.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No detrimental conditions were noted at the time of inspection.	
ANY NOTICEABLE SEEPAGE	Seepage (100 gpm) was noted at the toe of the dam extending for a distance of about 250 feet from near the left abutment to about 50 feet to the right of the reservoir drain outlet.	The source of the seepage could not be identified at the time of inspection. The condition should be further investigated and appropriate action taken.
STAFF GAGE AND RECORDER	None.	

Sheet 5 of 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The conduit is constructed through the base of the embankment; therefore, it could not be inspected.	
INTAKE STRUCTURE	Submerged and could not be inspected.	
OUTLET STRUCTURE	The reservoir drain outlet is enclosed in a steel plate box. The control valve which is located inside the steel plate structure was inaccessible during the inspection.	
OUTLET CHANNEL	The natural stream channel is the outlet channel.	
EMERGENCY GATE	The valve is located in the outlet structure.	The valve should be inspected and maintained on a regular basis. Provision should be made for emergency closure of the outlet pipe upstream of the embankment.

Sheet 6 of 11

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The concrete at the control section appears to be in good condition. No cracking or spalling of concrete surfaces were noted.	
APPROACH CHANNEL	The invert of the approach channel appears to be in good condition. No settlement was noted in the concrete sections. Some minor spalling of the concrete surfaces was noted in the sidewalls of the channel. No reinforcing steel is exposed at these locations.	Repair the minor spalling.
DISCHARGE CHANNEL	The concrete in the discharge channel appears to be in good condition. No settlement was noted in the concrete section. Seepage (1 gpm) was noted coming from the right sidewall of the spillway outlet chute about 30 feet downstream from the top of the dam.	The seepage should be periodically monitored to detect any increase in quantity of seepage or discoloration in the flow.
BRIDGE AND PIERS	The bridge constructed over the spillway appears to be in good condition.	
ENERGY DISSIPATOR	The energy dissipator appears to be undersized for the anticipated discharge.	

Sheet 7 of 11

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

Sheet 8 of 11

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

Sheet 9 of 11

RESERVOIR

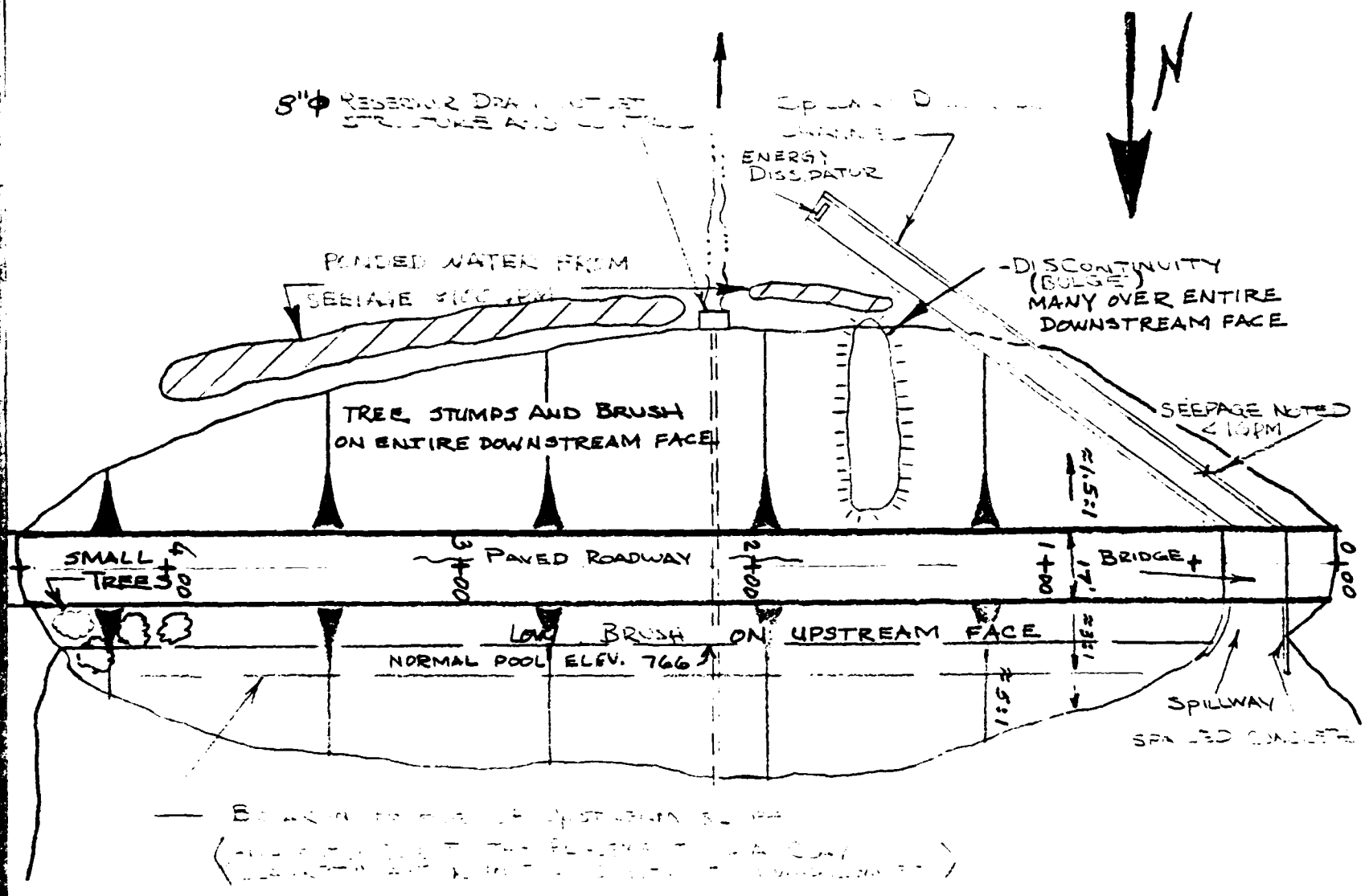
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The slopes to the reservoir are steep. No evidence of earth slides into the reservoir are apparent.	
SEDIMENTATION	No measurement of sedimentation was made. However, based on conversations with local residents and visual observations, the impoundment appears to be heavily silted.	

Sheet 10 of 11

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Small foot bridges and small channel stabilization structures are the extent of channel obstructions for approximately one half mile downstream of the dam.	
SLOPES	The overbanks of the downstream channel are relatively flat. The channel banks average about 2H:1V. The invert of the channel has an average gradient of about 1.3 percent.	
APPROXIMATE NO. OF HOMES AND POPULATION	5 homes are located within 1,500 feet downstream of the dam. The lowest door sill of the dwellings is about 5 feet above the stream bed. Between 20 and 30 people are associated with these houses.	

Sheet 11 of 11



DRAWING NOT TO SCALE

IMPOUNDMENT

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT: HEMLOCK LAKE DAM

SHEET: IIA

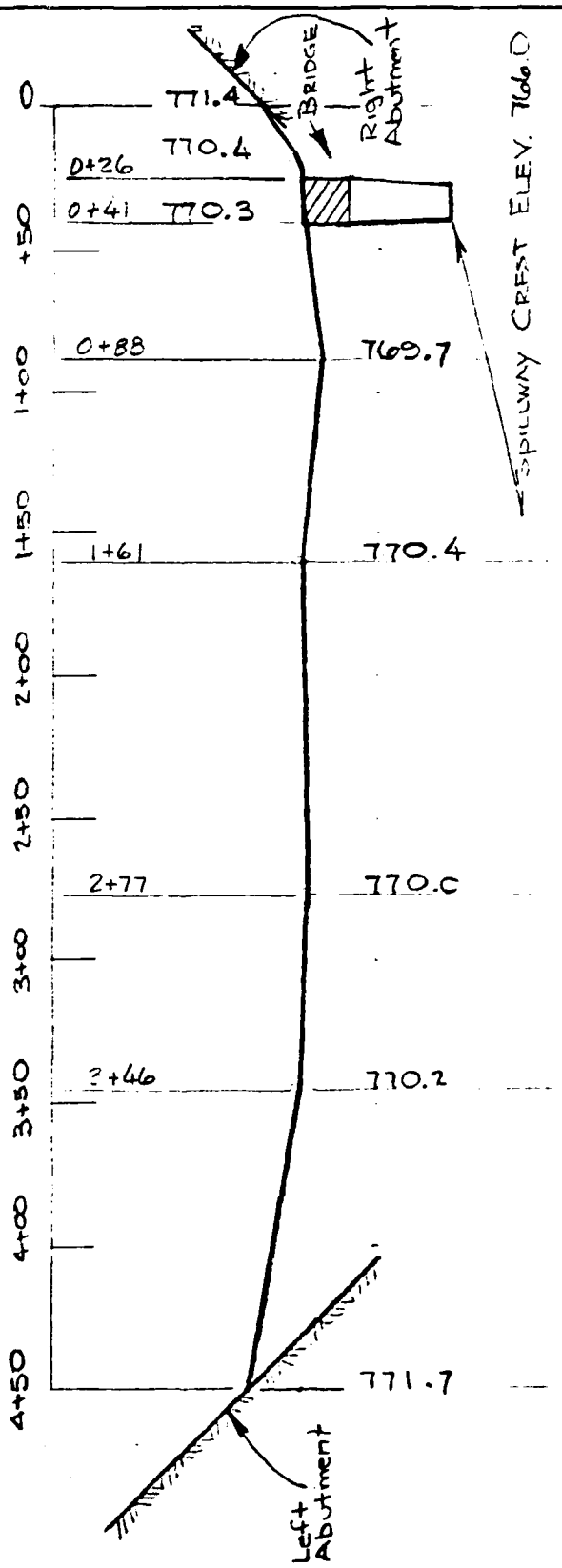
BY: REL

DATE:

JOB NO.:

O'BRIEN & GERE ENGINEERS, INC

SUBJECT	SHEET	BY	DATE	JOB NO
HEMLOCK LAKE DAM	11B	REH	2-10-81	1841 - 014



PROFILE CENTERLINE TOP OF DAM LOOKING DOWNSTREAM

SCALE: 1" = 60' HORIZ
1" = 5' VERT

DATE OF SURVEY 12/19/80

Note: Spillway Crest Elev. assumed from USGS quad sheet.

APPENDIX B

CHECKLIST
ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Hemlock Lake Dam

ID # PA 00571

ITEM	REMARKS
AS-BUILT DRAWINGS	No "as built" drawings are available.
REGIONAL VICINITY MAP	Refer to Appendix E, Figure 1.
CONSTRUCTION HISTORY	Refer to Section 1.2.g
TYPICAL SECTIONS OF DAM	Refer to Appendix E.
OUTLETS - PLAN	None availalbe.
DETAILS	None availalbe.
CONSTRAINTS	None available.
DISCHARGE RATINGS	None available.
RAINFALL/RESERVOIR RECORDS	Rainfall/reservoir records are not maintained by the Owner.

Sheet 1 of 4

ITEM	REMARKS
DESIGN REPORTS	None Available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available.
POST-CONSTRUCTION SURVEYS OF DAM	None available.
BORROW SOURCES	No information available.

Sheet 2 of 4

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	1. Spillway constructed in 1960. 2. Clay blanket placed on upstream slope in 1962. 3. Concrete cutoff constructed at spillway in 1962
HIGH POOL RECORDS	Records are not maintained by Owner.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None available.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	According to the Owner's representative, the embankment was overtopped during tropical storm Diane (1955). No spillway was constructed at this time.
MAINTENANCE OPERATION RECORDS	No maintenance records are maintained.

Sheet 3 of 4

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None available.
OPERATING EQUIPMENT PLANS & DETAILS	None available.
MISCELLANEOUS	

Sheet 4 of 4

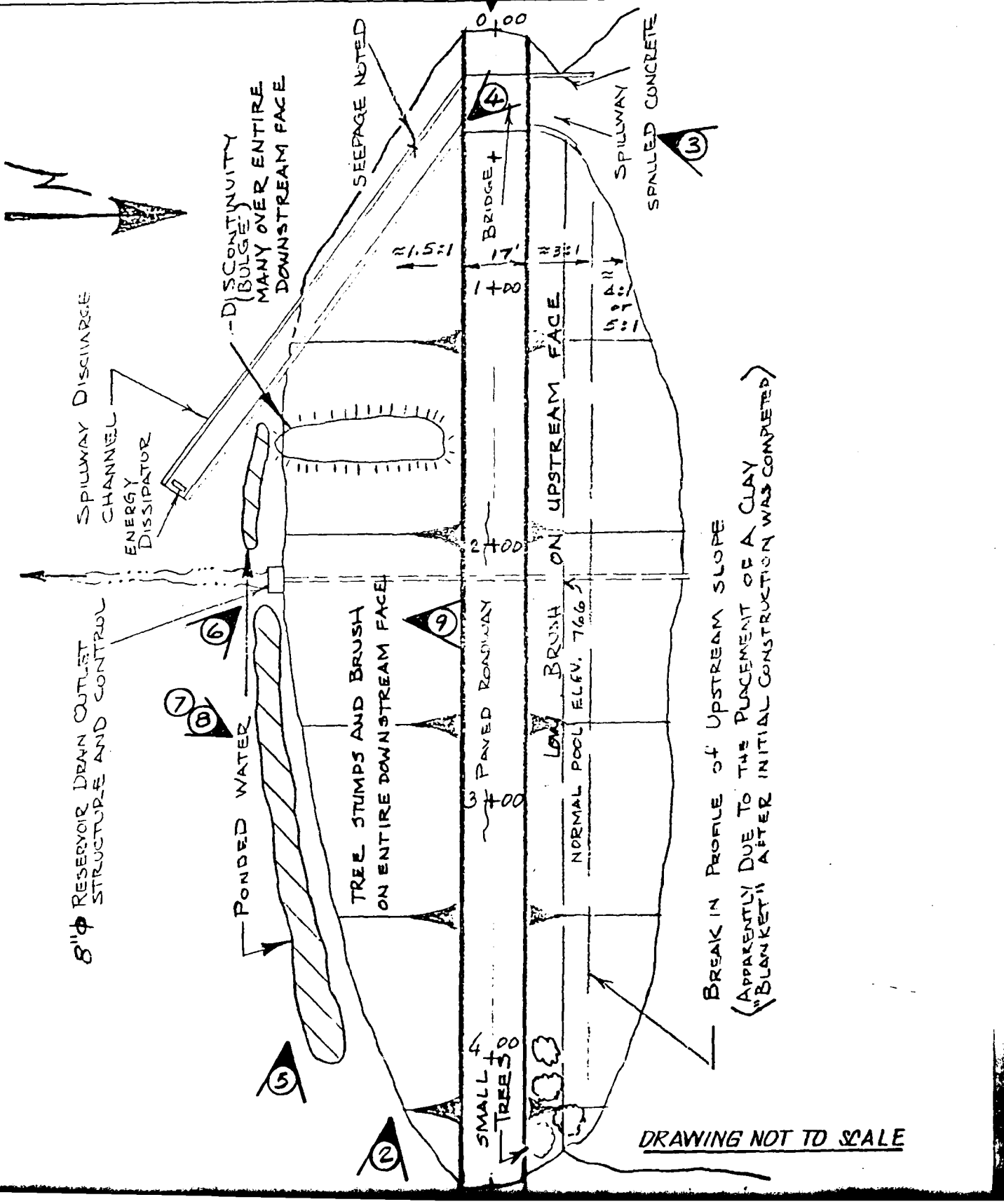
APPENDIX C

PHOTOGRAPHS

APPENDIX C
PHOTOGRAPH TABLE OF CONTENTS

O'BRIEN & GERE
ENGINEERS, INC

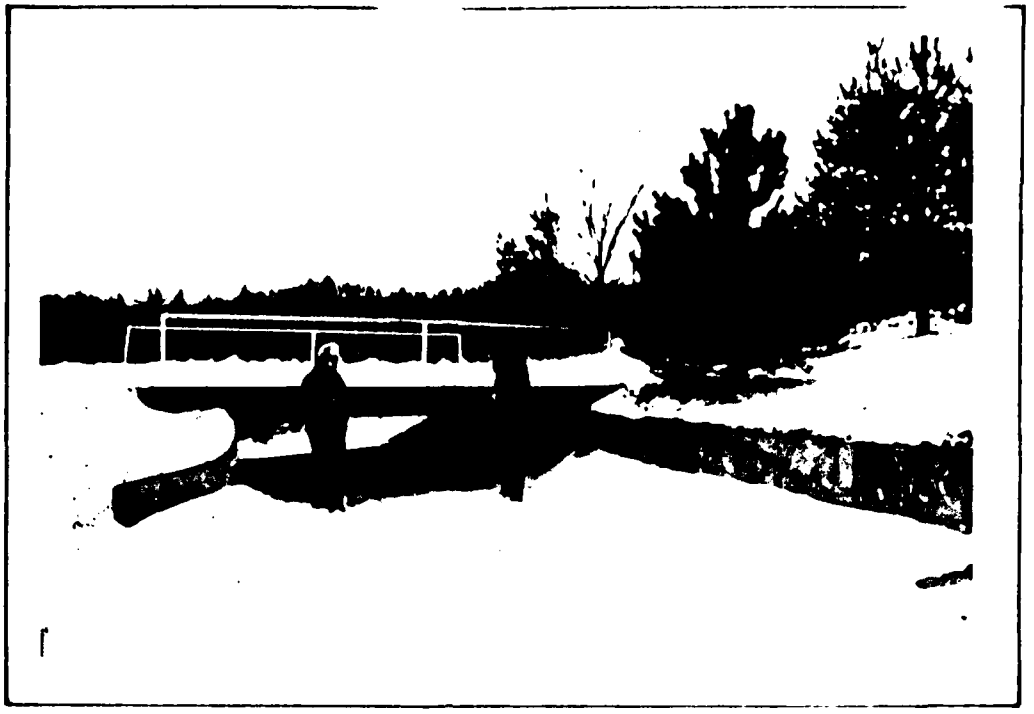
SUBJECT	SHEET	BY	DATE	JOB NO
HEMLOCK LAKE DAM	A	REH	2-10-81	1841-014



DRAWING NOT TO SCALE

1. VIEW ALONG THE TOP OF THE DAM FROM THE RIGHT ABUTMENT. (12/20/80)

2. VIEW ALONG THE TOP OF THE DAM FROM THE LEFT ABUTMENT. (12/20/80)



3. LOOKING DOWNSTREAM AT THE SPILLWAY ENTRANCE CHANNEL. (12/20/80)

4. LOOKING DOWNSTREAM AT THE SPILLWAY EXIT CHANNEL.

5. TYPICAL VIEW OF THE DOWNSTREAM FACE OF THE DAM. (12/20/80)

6. RESERVOIR DRAIN OUTLET. (12/20/80)

7. SEEPAGE AT THE DOWNSTREAM TOE OF THE DAM. (12/20/80)

8. CLOSE-UP OF THE SEEPAGE AT THE DOWNSTREAM TOE OF THE DAM. (12/20/80)

9. DOWNSTREAM CHANNEL AS SEEN FROM THE TOP OF THE DAM. (12/20/80)

10. POTENTIAL DAMAGE AREA ABOUT 500 FEET DOWNSTREAM OF THE DAM. (12/20/80)

APPENDIX D

HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

HEMLOCK LAKE DAM
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

TABLE OF CONTENTS

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Rural, wooded, pasture land, some residential development especially in vicinity of dam and lake

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 766 MSL (0 Ac-Ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): ———

ELEVATION MAXIMUM DESIGN POOL: ———

ELEVATION TOP DAM, LOW PT. (STORAGE CAPACITY): 769.7 MSL (117 Ac. Ft.)

SPILLWAY

a. Elevation 766 MSL

b. Type Concrete Channel Section

c. Width ≈ 15 feet

d. Length ≈ 18 feet (level section) outlet concrete channel chute ≈ 200 Ft. long

e. Location Spillover Right Abutment

f. Number and Type of Gates None

OUTLET WORKS:

a. Type 8-inch diameter cast iron pipe

b. Location At low point of valley

c. Entrance inverts ≈ 744 MSL

d. Exit inverts ≈ 743 MSL

e. Emergency draindown facilities 8-inch diameter control valve at outlet structure

HYDROMETEOROLOGICAL GAGES:

a. Type None in watershed

b. Location N/A

c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE: Not known

* Elevations estimated from USGS quad.

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed 1/

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out.

1/ "High" hazard structures only

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
HEMLOCK LAKE DAM	3	REH	2-6-81	1841-014
		VH	3/20/81	

HYDROLOGY

- DRAINAGE AREA (Planimetered from USGS Quad Sheet)
  = .48 Sq Mi.

- SPILLWAY DESIGN FLOOD (SDF)

  Size Classification - Small
  Hazard Classification - High

  SDF Range ½ PMF to PMF

  USE ½ PMF

- PMP Assessment (HR #33)

Hemlock Lake Dam is located in Zone Number 6

PMP ≈ 23" (200 sq miles - 24 hours)

Distribution

Time (Hrs)	Percent	Rainfall (Inches)
6	112	25.8
12	124	28.5
24	132	30.4
48	142	32.7

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
HEMLOCK LAKE DAM	4	REH	2-9-81	1691-014

3/20/81

HYDROLOGY (CONT.)

- SNYDER COEFFICIENTS (Provided By Balt Dist COE)
  Zone 2

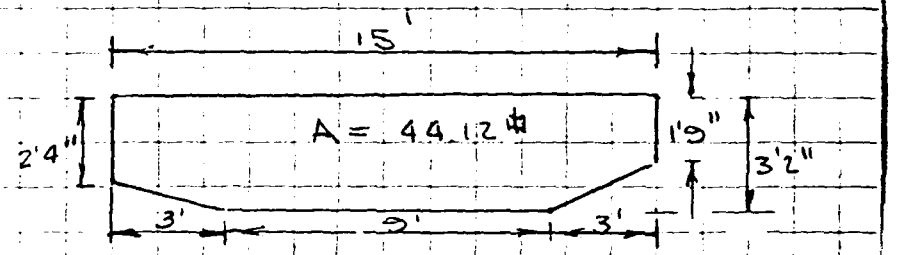
$C_p = .45$

$t_p = 2.1 (L \cdot L_{CA})^{.3}$ $\quad L = .95$ miles, $L_{CA} = .38$ miles

$t_p \approx 1.5$ hrs

HYDRAULICS

Spillway Section (upstream)



Due to the relatively steep slope of the spillway channel, assume inlet control.

Develop equivalent rect culvert retaining height of opening

$$L = \text{Area}/h = 44.12/3'2'' = 13.93'$$

O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
HEMLOCK LAKE DAM	5	REH JB	2-9-81 3/20/81	1841-014

HYDRAULICS (Cont)

-Spillway Rating - use nomograph solution (Refer to Sheet 5A)

WSE	HW	HW/H	Q/B	B	Q CFS
766	0	0	0	6	0
767	1	.32	2.7	13.93	38.
768	2	.63	6.8		95.
769	3	.95	13.0		181.
770	4	1.26	19.0		265.
771	5	1.58	23.0		320.
772	6	1.90	28.0		390.
773	7	2.22	31.0		432.
774	8	2.53	34.0		474.
775	9	2.85	36.0		502.
776	10	3.16	40.0		557.

- Reservoir Storage (Planimetered from USGS Quad Sheet)

Surface Area @ no pool (740.0) ≈ 0 Ac
Surface Area @ normal pool (766.0) ≈ 9.2 Ac
Surface Area @ elev 780 ≈ 18.4 Ac

- Embankment Overtopping

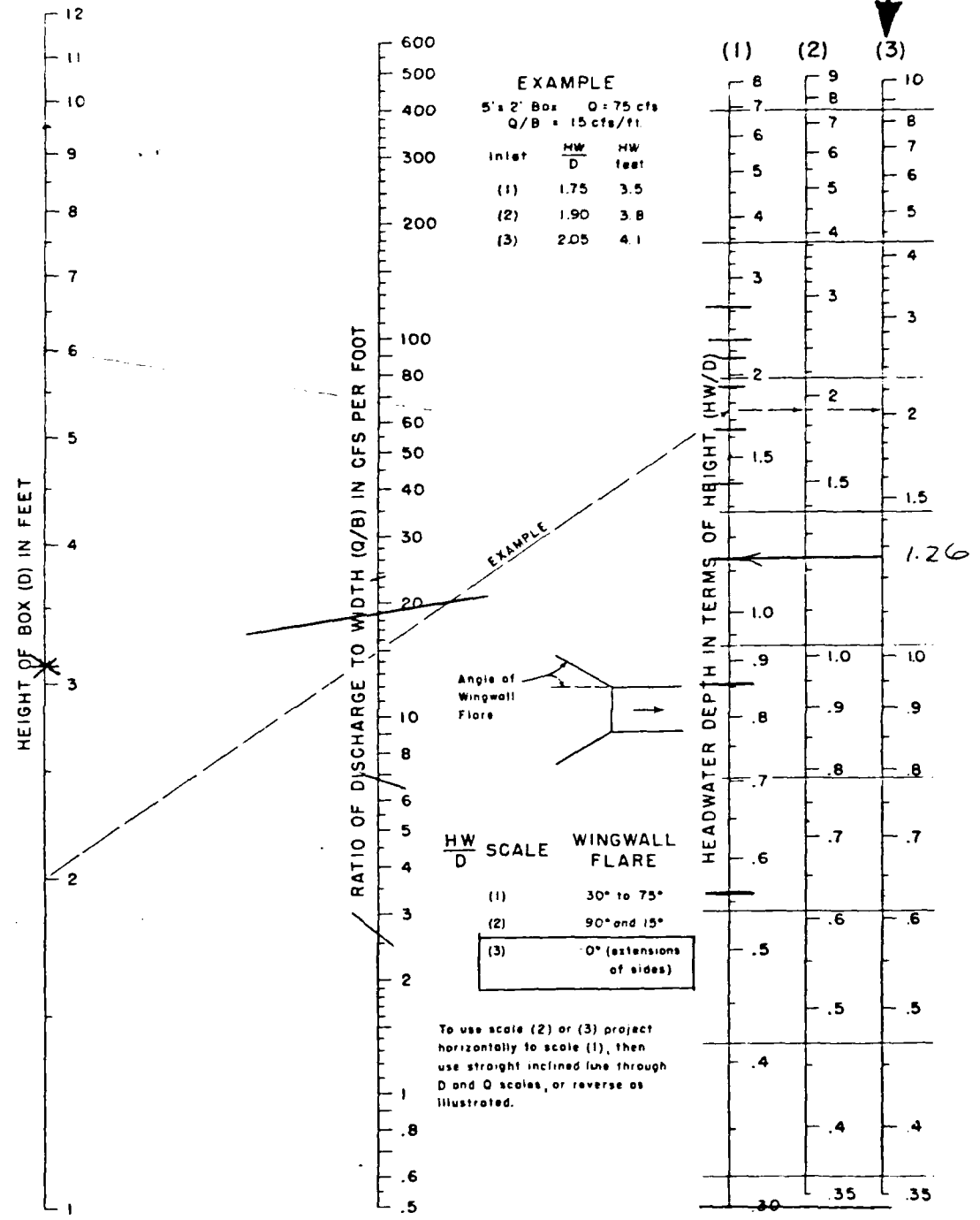
Length of Embankment assumed for overtopping = 433.7 feet

Length	0'	54.8'	218.3'	272.5'	318.9'	407.2'	433.7'
Elevation	769.7	770.0	770.2	770.3	770.4	771.4	771.7

Low Pt. Top of Dam = 769.67 use 769.7 in HEC-1
Assumed Coefficient of Discharge = 3.0

SHEET 6

CHART 1

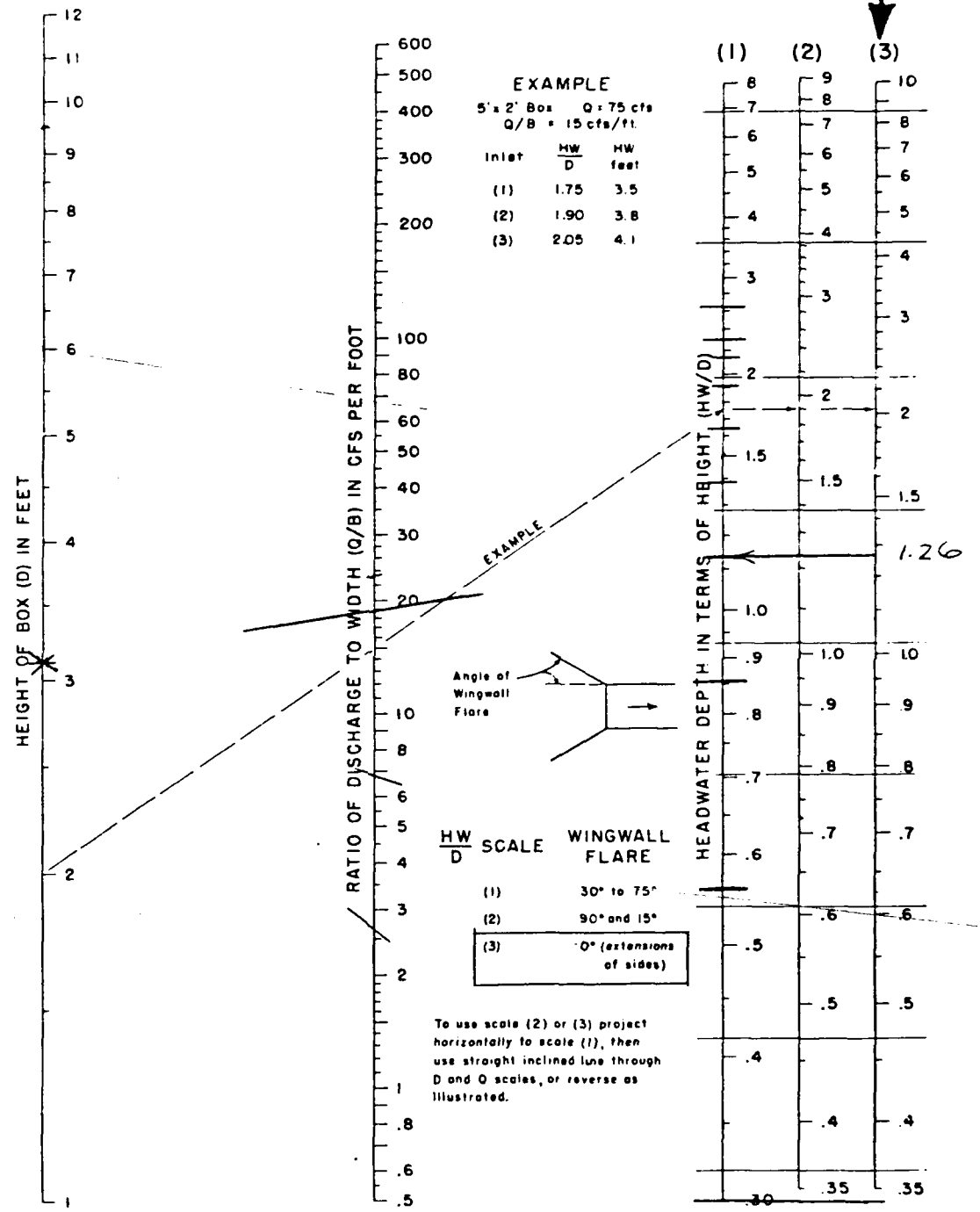


HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN 1963

SHEET 6

CHART 1



H=3.16

HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN 1963

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  01 APR 80
 **********
     1                A1                        NATIONAL DAM INSPECTION PROGRAM
     2                A2                              HEMLOCK LAKE
     3                A3                            PMF HYDROGRAPH
     4                B    300       0      15       0       0       0       0       0      -4       0
     5                B1     5
     6                J      1       6       1
     7                J1     .1      .2      .3      .4      .5     1.0
     8                K      0  INFLOW                                       1
     9                K1                          RUNOFF TO HEMLOCK LAKE
    10                M      1       1     .48                                                    1
    11                P      0      23     112     124     132     142
    12                T                                                  1.0     .05
    13                W   1.5     .48
    14                X  -1.5    -.05       2
    15                K      1  OUTFLO                                       1
    16                K1                        ROUTING THROUGH HEMLOCK LAKE
    17                Y                               1       1
    18                Y1     1                                           -766      -1
    19                Y4   766     767     768     769     770     771     772     773     774     775
    20                Y5     0      38      95     181     265     320     390     432     474     502
    21                $A     0     9.2    18.4
    22                $E   740     766     780
    23                $$   766
    24                $D 769.7       3     1.5   433.7
    25                $L     0    54.8   218.3   272.5   318.9   407.2   433.7
    26                $V 769.7   770.0   770.2   770.3   770.4   771.4   771.7
    27                K     99
     1                      PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                RUNOFF HYDROGRAPH AT      INFLOW
                                ROUTE HYDROGRAPH TO       OUTFLO
                                END OF NETWORK

1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION     JULY 1978
   LAST MODIFICATION  01 APR 80
 **********

 RUN  DATE# 81/04/22.
      TIME# 06.34.32.
```

NATIONAL DAM INSPECTION PROGRAM
HEMLOCK LAKE
PMF HYDROGRAPH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 6 LRTIO= 1
RTIOS= .10 .20 .30 .40 .50 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO HEMLOCK LAKE

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

	IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
	1	1	.48	0.00	.48	0.00	0.000	0	1	0

PRECIP DATA

	SPFE	PMS	R6	R12	R24	R48	R72	R96
	0.00	23.00	112.00	124.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .000

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.50 CP= .45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 54 END-OF-PERIOD ORDINATES, LAG= 1.51 HOURS, CP= .45 VOL= 1.00

5.	20.	41.	63.	82.	93.	93.	85.	76.	69.
62.	56.	50.	45.	40.	36.	33.	29.	26.	24.
21.	19.	17.	16.	14.	13.	11.	10.	9.	8.
7.	7.	6.	5.	5.	4.	4.	4.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.						

Sh 8

0 END-OF-PERIOD FLOW

MO.DA	HR:MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR:MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.13	23.74	2.39	29872.
										(664.)	(603.)	(61.)	(840.22)

HYDROGRAPH ROUTING

ROUTING THROUGH HEMLOCK LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTFLO	1	0	0	6	6	1	6	6

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	766.	1

STAGE	766.00	767.00	768.00	769.00	770.00	771.00	772.00	773.00	774.00	775.00
FLOW	0.00	38.00	95.00	181.00	265.00	320.00	390.00	432.00	474.00	502.00
SURFACE AREA=	0.	9.	18.							
CAPACITY=	0.	80.	269.							
ELEVATION=	740.	766.	780.							

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
766.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
769.7	3.0	1.5	434.

CREST LENGTH AT OR BELOW ELEVATION	0.	55.	218.	273.	319.	407.	434.
	769.7	770.0	770.2	770.3	770.4	771.4	771.7

PEAK OUTFLOW IS 85. AT TIME 43.00 HOURS

PEAK OUTFLOW IS 187. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 296. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 455. AT TIME 41.75 HOURS

PEAK OUTFLOW IS 585. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 1180. AT TIME 41.25 HOURS

5 of 9

1 ********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50	RATIO 6 1.00
HYDROGRAPH AT	INFLOW	.48	1	118.	236.	355.	473.	591.	1182.
		(1.24)		(3.35)(	6.70)(	10.04)(	13.39)(	16.74)(	33.48)(
ROUTED TO	OUTFLO	.48	1	85.	187.	296.	455.	585.	1180.
		(1.24)		(2.41)(	5.29)(	8.40)(	12.89)(	16.56)(	33.40)(

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	766.00	766.00	769.70
STORAGE	80.	80.	118.
OUTFLOW	0.	0.	240.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	767.83	0.00	97.	85.	0.00	43.00	0.00
.20	769.07	0.00	111.	187.	0.00	42.75	0.00
.30	770.11	.41	122.	296.	2.75	42.50	0.00
.40	770.41	.71	126.	455.	4.25	41.75	0.00
.50	770.55	.85	127.	585.	5.00	41.50	0.00
1.00	771.00	1.30	133.	1180.	8.50	41.25	0.00

1**********

34 10

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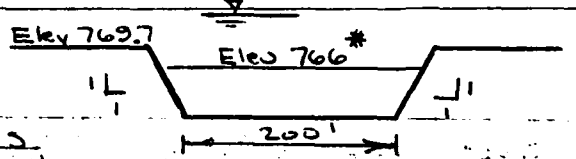
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1          A1                    NATIONAL DAM INSPECTION PROGRAM
    2          A2                        HEMLOCK LAKE
    3          A3                      PMF HYDROGRAPH
    4          B    300      0      15      0      0      0      0      0     -4      0
    5          B1     5
    6          J      2      1       1
    7          J1    .5
    8          K      0  INFLOW                                    1
    9          K1                      RUNOFF TO HEMLOCK LAKE
   10          M      1      1     .48                                          1
   11          P      0     23     112     124     132     142
   12          T                                                 1.0     .05
   13          W    1.5    .45
   14          X    1.5    .05       2
   15          K      1  OUTFLO                                    1
   16          K1                    ROUTING THROUGH HEMLOCK LAKE
   17          Y                             1       1
   18          Y1     1                                         -766      -1
   19          Y4   766    767     768     769     770     771     772     773     774     775
   20          Y5     0     38      95     181     265     320     390     432     474     502
   21          $A     0    9.2    18.4
   22          $E   740    766     780
   23          $I   766
   24          $D 769.7      3     1.5   433.7
   25          $L     0   54.8   218.3   272.5   318.9   407.2   433.7
   26          $V 769.7  770.0   770.2   770.3   770.4   771.4   771.7
   27          $B   200      1     740       2     766  770.15
   28          $B   200      1     740       2     766     775
   29          K      1  BREACH                                    1
   30          K1                    ROUTING DOWNSTREAM TO DAMAGE CENTER
   31          Y                             1       1
   32          Y1     1                                           1
   33          Y6   .07     .04     .07     720     740    1000     .02
   34          Y7     0     740      75     730     140     723     146     720     156     720
   35          Y7   162     723     512     730     862     740
   36          K     99
1                          PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                    RUNOFF HYDROGRAPH AT      INFLOW
                    ROUTE HYDROGRAPH TO       OUTFLO
                    ROUTE HYDROGRAPH TO       BREACH
                    END OF NETWORK
```

Elevs 770.1 & 775



* starting water surface elevations

Dam Breach Statement

The portion of dam assumed to be breached is based on the geometry of the site. The depth of flow over the top of the dam at which failure is initiated and the elasped time to complete failure are based on the general appearance and age of the structure. Consideration was given to the parameters used in the C.O.E. publication "Basic Concepts of Dam Breaks and Development of Dam Break Hydrographs."

NATIONAL DAM INSPECTION PROGRAM
HEMLOCK LAKE
PMF HYDROGRAPH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RUNOFF TO HEMLOCK LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.48	0.00	.48	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	124.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.50 CP= .45 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 54 END-OF-PERIOD ORDINATES, LAG= 1.51 HOURS, CP= .45 VOL= 1.00

5.	20.	41.	63.	82.	93.	93.	85.	76.	69.
62.	56.	50.	45.	40.	36.	33.	29.	26.	24.
21.	19.	17.	16.	14.	13.	11.	10.	9.	8.
7.	7.	6.	5.	5.	4.	4.	4.	3.	3.
3.	2.	2.	2.	2.	1.	1.	1.	1.	1.
1.	1.	1.	1.						

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.13	23.74	2.39	29872.
										(664.)	(603.)	(61.)	(840.22)

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********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING THROUGH HEMLOCK LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTFLO	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-766.	-1

STAGE	766.00	767.00	768.00	769.00	770.00	771.00	772.00	773.00	774.00	775.00
FLOW	0.00	38.00	95.00	181.00	265.00	320.00	390.00	432.00	474.00	562.00
SURFACE AREA=	0.	9.	18.							
CAPACITY=	0.	80.	269.							
ELEVATION=	740.	766.	780.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
766.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
769.7	3.0	1.5	434.

CREST LENGTH AT OR BELOW ELEVATION	0.	55.	218.	273.	319.	407.	434.
	769.7	770.0	770.2	770.3	770.4	771.4	771.7

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
200.	1.00	740.00	2.00	766.00	770.15

BEGIN DAM FAILURE AT 40.75 HOURS

PEAK OUTFLOW IS 2663. AT TIME 41.42 HOURS

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
200.	1.00	740.00	2.00	766.00	775.00

PEAK OUTFLOW IS 585. AT TIME 41.50 HOURS

W/H
13

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTING DOWNSTREAM TO DAMAGE CENTER

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
BREACH	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	CLNUT	ELMAX	RLNTH	SEL
.0700	.0400	.0700	720.0	740.0	1000.	.02000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 740.00 75.00 730.00 140.00 723.00 146.00 720.00 156.00 720.00
162.00 723.00 512.00 730.00 862.00 740.00

STORAGE	0.00	.29	.69	1.20	2.71	5.73	10.26	16.29	23.84	32.89
	43.40	55.04	67.76	81.56	96.45	112.41	129.46	147.59	166.80	187.09
OUTFLOW	0.00	61.01	210.25	458.84	944.96	1831.87	3277.08	5413.90	8362.38	12233.58
	17267.09	23498.88	30830.70	39314.26	49001.90	59946.04	72198.73	85811.57	100835.56	117321.06
STAGE	720.00	721.05	722.11	723.16	724.21	725.26	726.32	727.37	728.42	729.47
	730.53	731.58	732.63	733.68	734.74	735.79	736.84	737.89	738.95	740.00
FLOW	0.00	61.01	210.25	458.84	944.96	1831.87	3277.08	5413.90	8362.38	12233.58
	17267.09	23498.88	30830.70	39314.26	49001.90	59946.04	72198.73	85811.57	100835.56	117321.06

MAXIMUM STAGE IS 725.9

MAXIMUM STAGE IS 723.4

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .50
HYDROGRAPH AT	INFLOW	.48	1	591.
		(1.24)		(16.74)(
			2	591.
				(16.74)(
ROUTED TO	OUTFLO	.48	1	2540.
		(1.24)		(71.93)(
			2	585.
				(16.56)(
ROUTED TO	BREACH	.48	1	2640.
		(1.24)		(74.76)(
			2	585.
				(16.57)(

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1

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	766.00	766.00	769.70
STORAGE	80.	80.	118.
OUTFLOW	0.	0.	240.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	770.41	.71	126.	2663.	.83	41.42	40.75

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	766.00	766.00	769.70
STORAGE	80.	80.	118.
OUTFLOW	0.	0.	240.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	770.55	.85	127.	585.	5.00	41.50	0.00

PLAN 1 STATION BREACH

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2640.	725.9	41.50

PLAN 2 STATION BREACH

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	585.	723.4	41.50

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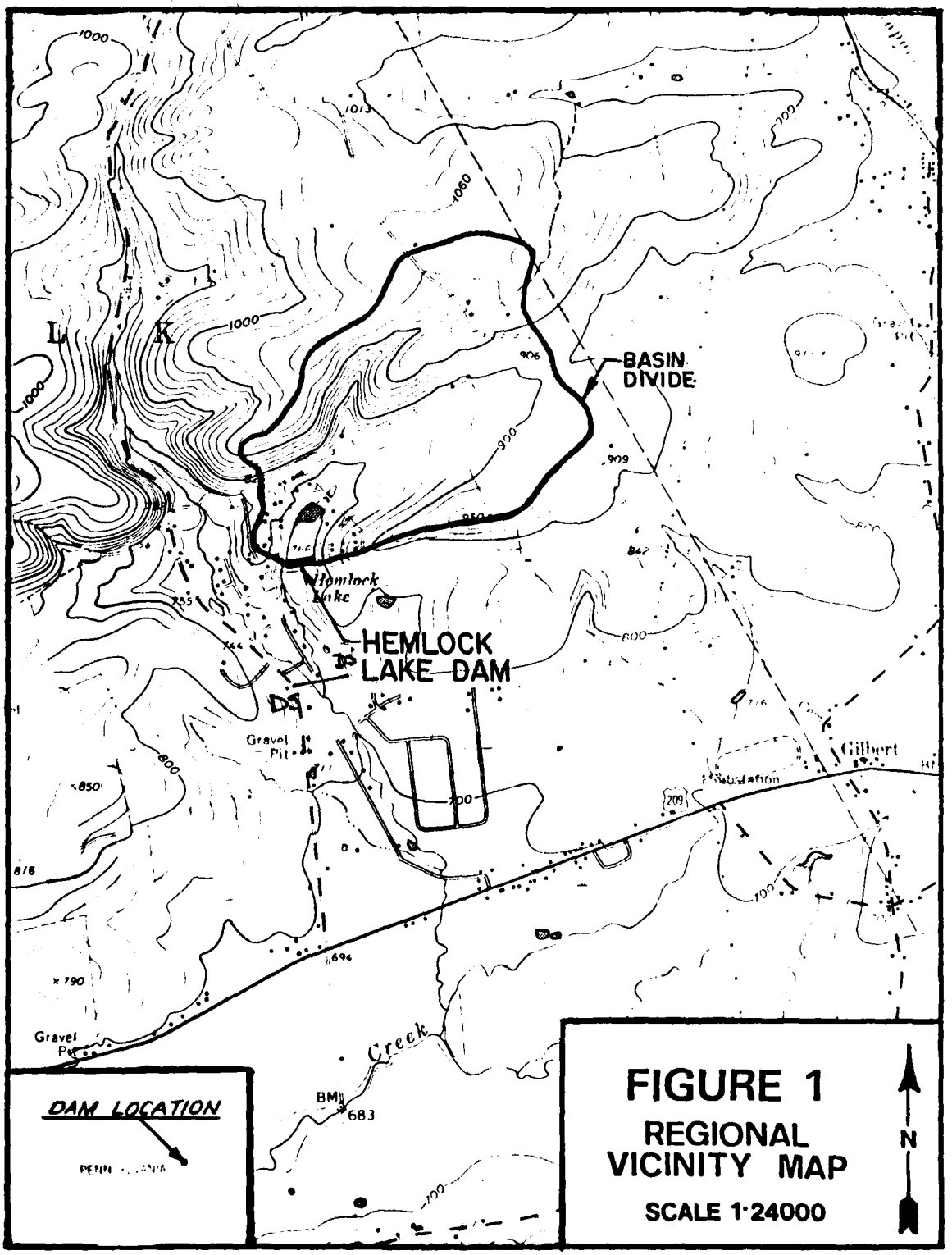
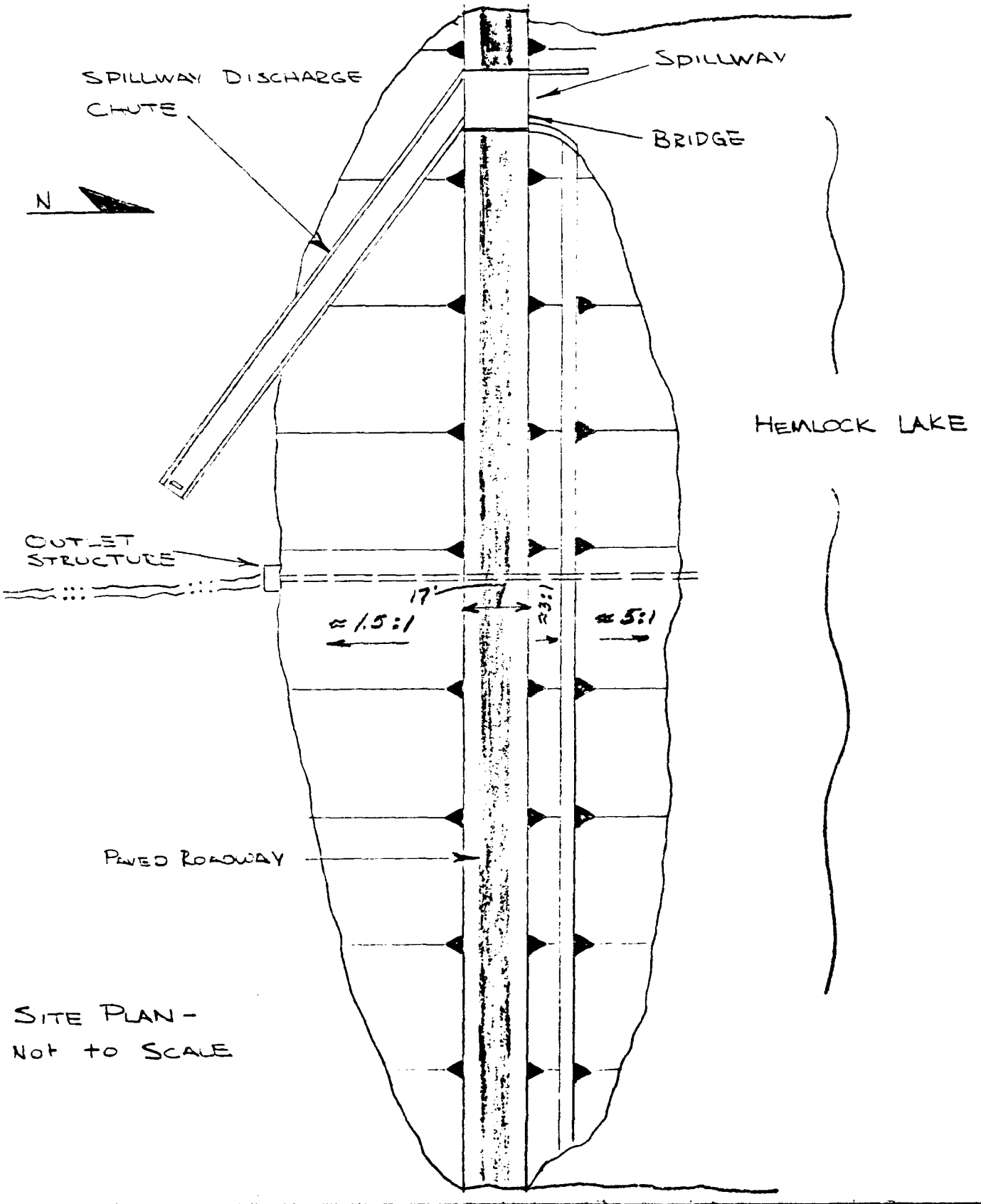
APPENDIX E

REGIONAL VICINITY MAP
&
DRAWINGS

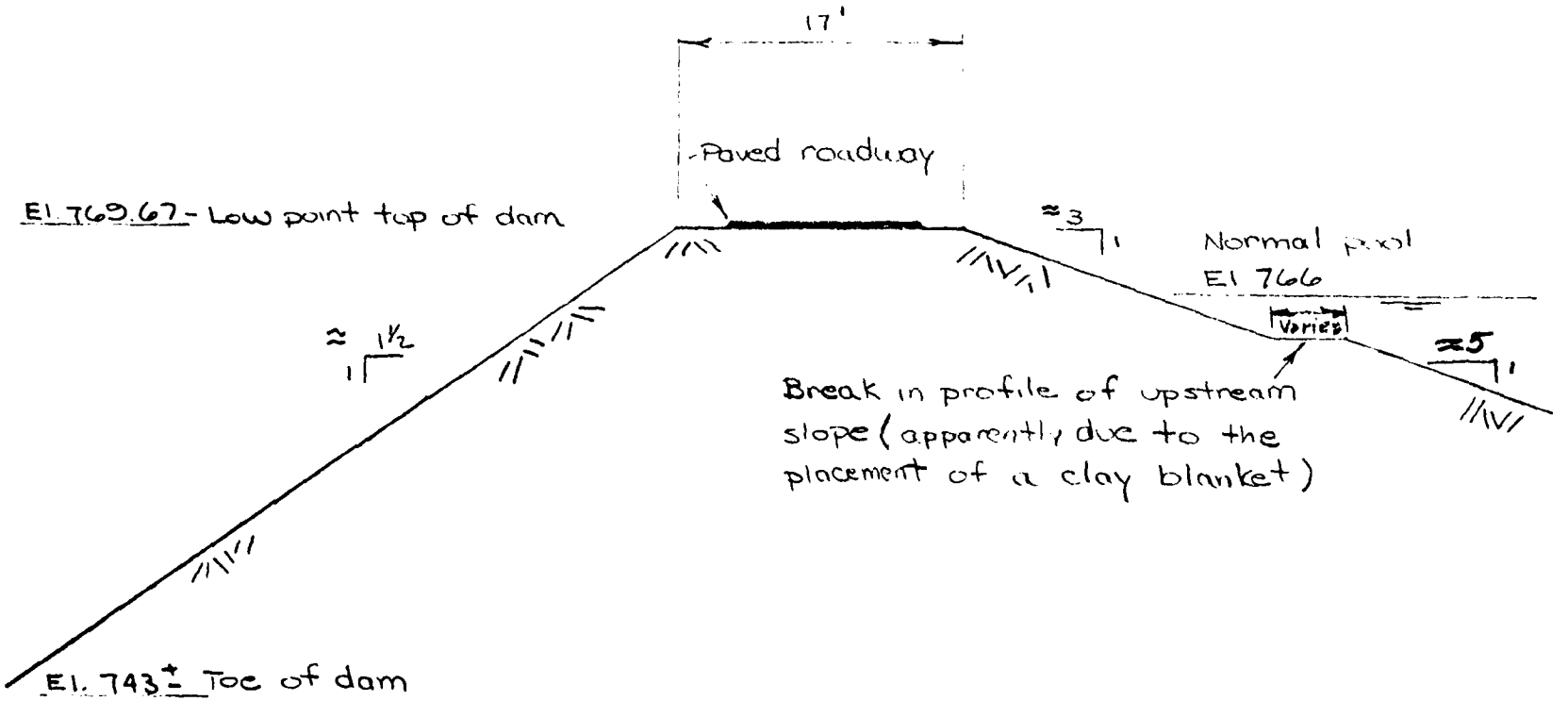

BASIN DIVIDE
HEMLOCK LAKE DAM
Hemlock Lake
Gravel Pit
Gravel Pit
Creek
DAM LOCATION
FIGURE 1
REGIONAL VICINITY MAP
SCALE 1·24000
N

O'BRIEN & GERE ENGINEERS, INC

SUBJECT	SHEET	BY	DATE	JOB NO
HEMLOCK LAKE DAM	2	REH	3/20/81	1841-014



SITE PLAN -
NOT TO SCALE



ASSUMED EMBANKMENT SECTION

O'BRIEN & GERE ENGINEERS, INC.

SUBJECT	SHEET	BY	DATE	JOB NO.
HEMLOCK LAKE DAM	3	REH	5/20/81	1841.014

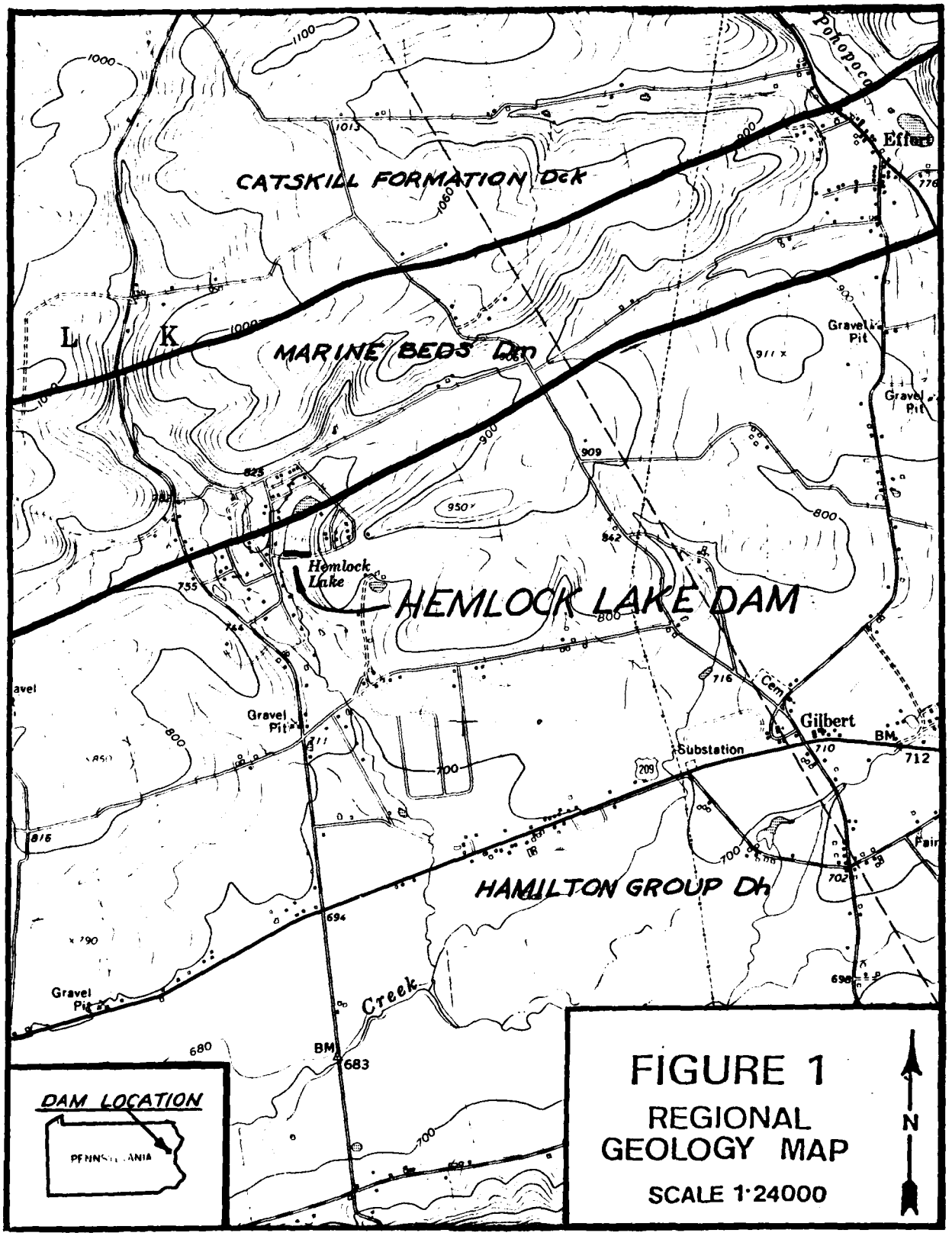
APPENDIX F

GEOLOGY

SITE GEOLOGY

HEMLOCK LAKE DAM

Hemlock Lake Dam is located in the Southern New York Section of the Appalachian Plateau Physiographic Province. As shown in Figure 1, bedrock at the damsite is composed of a shale/sandstone combination known as the Hamilton Group of the Middle Devonian period. The shales are brown to olive in color. The interbedded sandstones are dominant in places, highly fossiliferous in the upper stratas and contain "centerfield coral beds" especially in the region of the site. No known active faults or structural defects are known to be located in the vicinity of the dam and lake.


CATSKILL FORMATION Dck
MARINE BEDS Dm
HEMLOCK LAKE DAM
Hemlock Lake
Gravel Pit
Gravel Pit
Gravel Pit
Gravel Pit
Gilbert
Substation
Cem
BM
712
710
HAMILTON GROUP Dh
Creek
BM
683
680
Effner
Pohopoco
DAM LOCATION
PENNSYLVANIA
FIGURE 1
REGIONAL
GEOLOGY MAP
SCALE 1:24000
N


DAT
ILM